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ABSTRACT

This paper reviews and summarizes the literature on community college developmental mathematics programs in order to determine what the colleges are doing--in terms of placement, techniques, course content, and grading policies--to meet the needs of students lacking basic mathematical skills. Studies show that 10% to 50% of all community college students are mathematically underprepared, and that the majority of two-year colleges offer remedial math programs. Though most are taught using traditional lecture methods, alternative methods in use include programmed texts, tutoring, math labs, independent study, and mini courses. These programs generally provide an individual student-teacher relationship in self-paced mastery learning settings, resulting in a higher student self-image, and a loss of test fear through the technique of retesting. Although comparative studies generally show non-significant results for programs using alternative methods, benefits in student attitudes and in other factors must also be considered in evaluating the effectiveness of alternative programs. A 33-item bibliography is appended. (RT)

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ALTERNATIVE PROGRAMS

IN MATHEMATICS

IN THE COMMUNITY COLLEGES

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INTRODUCTION

Which comes first: mathematical theory or technological advance? Regardless of the philosophical answer to this primal question, there is no question that our society is becoming more technological and hence the need for mathematical skills increases. In addition to the general consideration, the large increase in non-traditional students, particularly at the community colleges, has meant that there are more students in higher education who lack basic mathematical skills.

Zwerling (33) estimates that at Palm Beach Junior College the number of these "mathematically illiterates" (9) approaches 50%. More systematic studies (1, 2) have indicated that mathematically underprepared students constitute anywhere from 10% to 50% of the total at community colleges. Underprepared students bring with them a legacy of content lack, weak study habits, poor self images, diffused goals, unsuccessful learning experiences and a dislike for mathematics (1), compounded by poor verbal skills (3).

These students not only need specific knowledge, but need to be shown that they can learn and that the skills are useful. Much of educational theory emphasizes the desirability of meeting the student where he is and therefore of developing an appropriate curriculum. What, therefore, are the community colleges doing, in terms of placement, techniques, course content, grading policies - in short, in terms of curriculum content and practices - to help move these students toward their educational goals? And what, if any, has been the success of such attempts?

The assumption is not that the lecture method with traditional textbooks

is inherently inappropriate.

> "(Although) most of the innovative teaching projects have very little influence on 95% of teaching, ... this is the normal life cycle of teaching innovation. ... The teaching innovation that evolves back to the traditional prototype leaves tradition changed in some way. ... Only by continually trying out new ideas can we grow, and if we do not grow, we gradually die."

SCOPE OF DEVELOPMENTAL COURSES IN THE COMMUNITY COLLEGES

Our primary concern here is with developmental programs, which include courses in arithmetic and algebra and less often in geometry and trigonometry. The number of community colleges that offer developmental programs is at least half: 60% of the 104 community colleges surveyed by Baldwin (1) offer such courses; Lindberg (12) found the figure to be 96% of those community colleges studied (all with large enrollment), as compared with 75% of the two- and four-year schools considered together; Carter (5), surveying six western states, found the incidence of remedial programs to be 90%. The percentage of student enrollment in these programs varies from 20% to 60%, due possibly to the emphasis put on such programs (5).

Recommendation* for placement in remedial programs is based on high school grades, teacher referrals, interviews, volunteerism, and, far from universally, placement examinations. Frierson (6) finds 27% use testing, while Baldwin reports that 38% do. Several of the successful programs reported in the literature are ones which feature testing for placement (9, 16, 32,

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*Although Beal estimates that half of community colleges require enrollment in developmental programs, Baldwin reports that only 4% do. Hence the use of "recommend" rather than "require". Whether placement should be mandatory is a question little considered, and apparently there has been no systematic attempt to correlate required placement with success, however defined. On the one hand, non-mandatory placement may have motivational benefits (33); on the other, it is nearly impossible for a student to progress in mathematics without a firm background.

33). Certainly mainly "successful" programs (more on success below) get reported. However, the fact that programs judged successful do include placement may infer a correlation between the two; unfortunately, this possibility has not been investigated.

THE TECHNIQUES: HOW DOES ONE MEASURE SUCCESS?

By far the largest percentage of developmental courses are taught by the traditional lecture method (1, 6, 12). While the lecture may diminish reading and language difficulties characteristic of many underprepared students (3), on the other hand non-middle class students may not have empathy with the instructor and his speech (18). For these non-middle class students, the lecturer himself is an authoritarian symbol against which to rebel (18). The major drawbacks of the lecture are lack of student participation, the necessity to aim the pace of the class at a non-existing middle, and that lecture learning is not often a pleasant experience (4, 30).

Alternative approaches to the straight lecture include, in approximate order of popularity, programmed texts, tutoring, mathematics laboratories, independent study, mini courses (1, 6). Although some studies have shown that students in alternative mathematics programs receive higher course grades than their counterparts in lecture sections (9, 33), in general comparative mean scores are not statistically significant (11, 20, 22, 23). That the students in alternative programs do as well as students in lecture sections shows that such programs are not a failure. But lack of failure does not necessarily imply success. However, there are features of alternative programs in which these programs surpass the lecture, particularly in relation to the individuals involved.

Attitude can play a large role in determining outcome. How a department

rates its program will be a factor in its success. Lindberg (12) found that the highest ratings were given by departments with some kind of individualized program. Frierson (6) found the correspondence between the number of non-lecture techniques and the feeling that student needs were being met to be statistically significant at the .02 level.

The lecturer is the expounder. The teacher in an alternative learning program, even if combined with lecture, is freed from a rigid role, allowing more flexibility and contact with students. One-to-one learning is the most effective (2); teachers not involved in only lecture are able to provide situations where one-to-one learning can take place. The teacher becomes tutor, guide, administrator. Freed from the necessity of presenting details, he can present concepts as part of a whole, show broad goals rather than specific ones (9), and give historical perspective. This is particularly true if the program allows for some group activity, either formally or informally.

Student reactions are a facet of utmost importance. While the few attempts to measure student attitude have not found this tested significantly, repeatedly researchers find that students like the alternative better (6, 11, 22, 27, 30, 32). It cannot be emphasized too much that underprepared students need positive learning experiences to facilitate acquisition of skills. Students with a history of failure in mathematics may not ask questions in discussion, and yet should have few problems in showing a programmed text, computer or trusted tutor this lack of understanding (33). When you know what you don't know, learning can begin to be effective. Many with past difficulties in mathematics become too easily frustrated when the lecturer moves on and leaves the slower learners behind; self-pacing is a practical

alternative. In addition, when the student learned and he enjoyed the process it took to get there, his self-image is raised.

Individualization of educational methods has several drawbacks. B. F. Skinner established the principle that if learning is to take place, a response must be made by the learning (4). The American educational system does not prepare students for an active role in the learning process (18, 30); however, with familiarity and encouragement this obstacle should be initial rather than permanent.

Students needing basic mathematics courses sometimes lack individual self-study skills and have low reading ability, both of which components are necessary if an individualized program is to have positive results. Procrastination can deter the effectiveness of self-paced programs. Much of the programmed materials available are boring; suitable materials for small groups or discovery techniques are not available. Taking the above into consideration, one is led to the conclusion that lecture can be a valuable component of individualized programs, and that a schedule, albeit flexible, may be necessary.

RETESTING.

A common feature in many alternative learning programs is the opportunity for retesting.

> "Much of our need to justify grades comes from ourselves. We are on the defensive when we know that grades do not say the things that need saying." (13, p. 51)

The arbitrariness that both instructors and students feel concerning grades can be alleviated by allowing students to take exams more than once (17). The mechanics of reststing vary: how many times, what level is considered

adequate, whether to disregard all but the highest grade, and so on. Retesting, which can raise a student's course grade, is most valuable if it is diagnostic (8, 9). Many students in developmental courses are experts at failing tests; retesting helps them to learn to pass tests (9) and reduces pressures of tests (8).

The heart of mastery learning, retesting can alleviate problems inherent in certain alternative programs. Williams (32) found retention rate low in a slide-tape program in a mathematics laboratory; Komaridis (cited in 14) found retention improved with retesting. Students who contract with the instructor often aim wrong and need to renegotiate the contract (15); retesting gives this flexibility (14).

NON-DEVELOPMENTAL MATHEMATICS

The emphasis in this study has been on developmental programs. Not every student in the community college needs remedial mathematics or wants to learn about algebra. Generally, most community colleges today do offer alternatives to the algebra-calculus sequence; however, the stress on manipulation continues - this is most easily measured and is where the instructor may feel most comfortable (17). Emphasizing historical or cultural aspects of mathematics gives breadth and life to a subject often intangible to students (17, 26). Mathematics courses can be built around a theme, with the aim of showing the mathematization of real and complex problems (17). Mini courses in this context have much to recommnd them: flexibility of content, of scheduling, and of course load; in addition, instructors teach what interests them, which should lead to more effective and captivating teaching (6, 26).

CONCLUSION.

In sum, this study, although not comprehensive, corroborates Gormley's statement (7, p. 462) that

> "what is needed at community colleges are courses in developmental mathematics that offer alternatives in learning based on the student's own learning style."

Specifically, this paper supports the following conclusions:

1. Community colleges have attempted to respond to the large numbers of students lacking basic skills in mathematics.

2. An effective placement program, coupled with good counselling, is needed to identify students with poor skills and to encourage them to enroll in such courses.

3. A variety of learning techniques, combining the advantages of lecture with those of controlled, self-paced instruction, should be made available to students.

4. Retesting is a valuable learning tool in developmental courses.

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